



1998–99 CATS ASSESSMENT

Open-Response Item Scoring Worksheet

Grade 7—Science

The **academic expectations** addressed by “Reducing Energy Use” are

- 2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.
- 2.3 Students identify and analyze systems and the ways their components work together or affect each other.

The **core content** assessed by this item includes

Content

- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
- Heat moves in predictable ways, flowing from warmer objects to cooler ones until both objects reach the same temperature.

Inquiry

- Thinking critically and logically to make the relationships between evidence and explanations

Reducing Energy Use

Electrical energy is used in buildings such as schools to provide electricity for machines, equipment, and heating and cooling units.

- a. Identify **two** changes in a school’s design that could be made to keep the use of electrical energy low.
- b. Identify **two** ways students and teachers in a school could help keep electrical energy usage low.



SCORING GUIDE

Grade 7 Science

Score	Description
4	Overall, the response is complete and shows a solid understanding of factors that affect energy transfer, consumption, and conservation. Two appropriate school design changes and two specific ways that students and teachers could help keep electrical energy usage low are clearly identified.
3	<p>Overall, the response shows understanding of factors that affect energy transfer, consumption, and conservation. Response may contain minor errors or omissions.</p> <p>Two appropriate school design changes and one specific way that students and teachers could help keep electrical energy usage low are identified.</p> <p>OR</p> <p>One appropriate school design change and two specific ways that students and teachers could help keep electrical energy usage low are identified.</p>
2	<p>Overall, the response shows a limited understanding of factors that affect energy transfer, consumption, and conservation. Response may lack some relevance and contain errors, misconceptions, or omissions.</p> <p>One school design change and one way that students and teachers could help keep electrical energy usage low are identified.</p> <p>OR</p> <p>Two school design changes are identified (with no ways that students and teachers could help).</p> <p>OR</p> <p>Two ways that students and teachers could help keep electrical energy usage low are identified (with no school design changes).</p>
1	Overall, the response is incomplete and shows a minimal understanding of factors that affect energy transfer, consumption, and conservation. There is an attempt to identify at least one school design change or one way that students and teachers could help keep electrical energy usage low. However, the response contains major errors, misconceptions, and omissions.
0	The response is totally incorrect or irrelevant.
Blank	No response.

Science Behind the Question:

Examples of school design changes: window coverings in summer, energy-efficient lights, double-paned glass, efficient heating/air conditioning systems, efficient insulation

Examples of ways that students and teachers could help keep electrical energy usage low: turning lights, overhead projector/other equipment off when rooms are not in use, keeping doors closed when air conditioning or heating is in use



ANNOTATED STUDENT RESPONSE

Grade 7 Science

Sample 4-Point Response of Student Work

Student Response

One thing that schools can do to keep electrical energy usage low is to have more windows. The more natural light you have, the less electrical energy you need for lights. One thing students and teachers can do is turn off lights when they are not using them. Schools could also put up a thicker exterior wall to trap in the warmth for winter and the coolness for summer. This would cut back on some more electrical energy. Another thing that students and teachers could do during warmer weather is to open the windows to keep the school cool.

← Student identifies an appropriate school design change that would reduce electrical energy use (i.e., having more windows).

← Student identifies one specific way that students and teachers could help keep electrical energy usage low (i.e., turning off lights when not in use).

← Student identifies a second appropriate school design change that would reduce electrical energy use (i.e., thicker exterior wall).

← Student identifies a second specific way that students and teachers could help keep energy usage low (i.e., opening the windows in warm weather).

Overall, the student demonstrates a solid understanding of factors that affect energy transfer, consumption, and conservation.



ANNOTATED STUDENT RESPONSE

Grade 7 Science

Sample 4-Point Response of Student Work

Student Response

There are many things at schools that use electricity. Sometimes we don't even think about how much it costs or how much we use it. We never think about how we can reduce the use of electricity, but we should.

Schools could be designed with less lights which will save electricity. Schools could also install more windows that can be opened so the schools won't have to turn on the air conditioning as much in warm weather.

The students and teachers could also help by doing simple things like turning off the lights when they leave classrooms. Also, everyone could bring a jacket to school in case they get cold. Then the teachers won't have to turn the heater on all the time.

These are some of the great ways to reduce the use of energy in schools and at home. At my house, we always turn off the lights. Our mom is always happier when she receives the bill.

← Student identifies two appropriate school design changes that would reduce electrical energy use (i.e., having less lights and adding more windows that open).

← Student identifies two specific ways that students and teachers could help keep electrical energy usage low (i.e., turning off lights when leaving classrooms and bringing jackets to school).

Overall, the response demonstrates a solid understanding of factors that affect energy transfer, consumption, and conservation.



ANNOTATED STUDENT RESPONSE

Grade 7 Science

Sample 3-Point Response of Student Work

Student Response

To keep the use of electrical energy low a school could use fewer ceiling lights and a school could buy less equipment that has to be plugged in. This would save a lot of electrical energy, if someone would buy equipment that uses batteries.

Teachers and students could keep electrical energy usage low by turning off computers while they aren't being used, and they could turn off classroom lights when they aren't in the classroom.

← Student identifies one appropriate school design change (i.e., using fewer ceiling lights). Student attempts to give a second school change; however, replacing “plugged in” equipment with battery-operated equipment does not represent a school design change.

← Student clearly identifies two specific ways that teachers could help keep electrical energy usage low (i.e., turning off computers when not in use and turning off lights when not in classroom).

Overall, the student demonstrates an understanding of factors that affect energy transfer, consumption, and conservation.



ANNOTATED STUDENT RESPONSE

Grade 7 Science

Sample 2-Point Response of Student Work

Student Response

One change to a school that would lessen the electrical bill would be to add insulation to the school. An extra layer of insulation would keep in heat or cool. It would cut down on heating and cooling bills.

Classrooms could turn off their lights when they leave. This would cut the electrical bill dramatically. By conserving our energy we can become much more cost efficient.

← Student identifies an appropriate school design change that would reduce electrical energy use (i.e., adding insulation).

← Student identifies one way that students and teachers could help keep electrical energy usage low (i.e., turning off lights when leaving classrooms).

Overall, the response demonstrates a limited understanding of factors that affect energy transfer, consumption, and conservation.

Sample 1-Point Response of Student Work

Student Response

The school could not use so many things just use what they need.

The students and teachers could keep the electricity low if they just used something only when needed. Like if the students are hot, they can open a window instead of turning on the air conditioner.

← Student attempts to identify a school design change, but it is too vague to receive credit.

← Student identifies one way that teachers and students could help keep electrical energy usage low (i.e., opening windows rather than using the air conditioner).

Overall, the student demonstrates a minimal understanding of factors that affect energy transfer, consumption, and conservation.



INSTRUCTIONAL STRATEGIES

Grade 7 Science

The open-response item **“Reducing Energy Use”** was designed to assess students’ ability to (1) suggest changes in school design that could provide alternative sources of energy or reduce energy losses and (2) suggest changes in behavior of teachers and/or students that could provide alternative energy sources or reduce energy losses. The instructional strategies below present ideas for helping students explore and master these concepts.

Discuss the following concepts and skills with students:

- Energy transfer including heat transfer
- Heat transfer by conduction, radiation, and convection
- Use of conductors and insulators to improve or reduce heat transfer in a variety of practical situations
- Comparison of alternative energy sources suitable for home or school (e.g., how efficient, how destructive to the environment)
- How to prepare an “energy budget” for a home or school
- How infra-red photography and sensors identify heat losses from buildings
- How air conditioning units and refrigerators work and how to assess their efficiency

Have students work individually, in pairs, in small groups, and/or as a class to complete any or all of the following activities:

- Measure the comparative R-value (insulating ratio) for different building materials (including insulation of a known value), using a lamp as a heat source and a thermometer both above and below the material.
- Research different kinds of windows that are available with a focus on how much energy is lost through each type of window (e.g., double/single glaze, argon-filled/vacuum-filled, tinted/film-covered, wood frame/metal frame). See if test samples are available for measuring heat transfer, using the lamp and thermometer apparatus described above. Report findings to the class.
- Investigate how much electricity is used per day by the school at different times of the year and on weekends. Prepare a report on ways that electrical energy use might be reduced at certain times of the day, week, and/or year.
- Find out how much electricity (in kilowatt hours) is used by each appliance or piece of equipment at the school or a home (including electric lights) in order to plan an electricity budget for the school or a home. Prepare charts showing where most electricity is used as a function of time of day, day of week, and time of year.
- Investigate how electric meters work. Contact the local electric company for information and demonstrations. Determine who the largest energy users are in your town or city and discuss possible reasons.
- Research alternative production methods for electricity and prepare a report on which is the least expensive and which is the most expensive. Identify other factors besides cost that must be considered when selecting the energy source you use.
- Identify items that use electricity that could be powered by a different form of energy. Prepare a report for the class on which substitutions might make sense and which are unlikely to be effective or appropriate.
- Prepare for and lead a class discussion on the advantages and disadvantages of switching from gasoline-powered cars to electric cars.
- Research and discuss advantages of electric cars over gasoline-powered ones.